Gender issues in African agriculture

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Gender Issues in African Agriculture: Evidence from Kenya, Tanzania and Côte d'Ivoire

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GENDER ISSUES IN AFRICAN AGRICULTURE:

EVIDENCE FROM KENYA, TANZANIA AND CÔTE D'IVOIRE

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PREFACE

In 1989 the World Bank commissioned a study on "Women, Public Services and Income Generation". Using rural survey data for three African countries the study addressed questions of gender differences in access to public services (primarily education, health and water supply) and in the generation of income. It was executed by S. Appleton, D.L. Bevan, P. Collier, L. Haddad and J. Hoddinott at the Centre for the Study of African Economies, Institute of Economics and Statistics, Oxford and by K. Burger and J.W. Gunning at the Economic and Social Institute, Free University, Amsterdam. In April 1991 a draft monograph was submitted as final report to the Bank under the title "Public Services and Household Allocation in Africa: Does Gender Matter?". The present text consists of Chapter 5 (Gender Issues in African Agriculture) of that report and the section on extension services of Chapter 4 (Water Supply, Extension and Credit).

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Gender Effects in Investment Decisions:
Coffee, Cocoa and Livestock Adoption

Introduction

In this section we consider the determinants of investment decisions in agriculture. Using rural survey data we estimate logits for the adoption of: coffee growing in Kenya; livestock in both Kenya and Tanzania; and coffee and cocoa in Côte d'Ivoire. For each of these five cases gender effects are considered. The logits capture three possible gender effects: differences between male and female headed households, differences in the effect on adoption of the availability in a household of male and female labour and, finally, the possibility that copying effects in adoption decisions are gender specific.

We first discuss the concept and measurement of copying effects and then consider investment decisions in turn for each of the three countries.

Copying Effects

Differences between households in adoption decisions may reflect differences in knowledge. For example, households may differ in their subjective estimates of the risk associated with a new activity such as coffee growing. These estimates of risk will change over time as information is generated by the activities of other households. More generally, the decision to innovate is likely to be influenced by information obtained from other households, either those who have already adopted the innovation or those who are considering the adoption decision. When this influence is positive we refer to it as a copying effect.

Copying has important policy implications, increasing the effectiveness of policies which directly induce innovation. In addition, the copying mechanism is a potential source of gender effects. For example, women may be more inclined to copy from other women than from men. As yet there is however little evidence on the importance of copying effects, either general or gender specific. Bevan et al. (1989) have considered the question for coffee and tea adoption in Kenya and Tanzania. However, their estimation procedure does not deal adequately with the simultaneity problem.

In their model the probability of adoption by household i is partly explained by a copying variable: the percentage of other adopters in the same cluster. This variable appears to be exogenous to household i, but when the adoption by the others adopters is explained by the same model, this is no longer valid. The numerator of 'the percentage other adopters in the cluster' is the number of households (excluding household i) which adopt. According to the model adoption by each of these households is related to the adoption of household i. Hence the probability that farm i adopts is indirectly related to whether or not farm i adopts. This is one of the "logically inconsistent" models discussed by Maddala (1983, p. 119). A further discussion of this type of simultaneous model, possible when formulated for continuous variables but impossible for discrete variables, is given by Cramer (1986, p. 181). We will adopt an approach which avoids this consistency problem.

We distinguish two types of copying: sequential and simultaneous. In the case of sequential copying the adoption of an innovation by a farmer raises the probability that other farmers will subsequently decide to adopt the same innovation. One reason is that later adopters have had an opportunity to observe the results obtained by those who have innovated earlier, the risk involved and the requirements of the new activity (e.g. in terms of cash and labour). This improves their information set and may thereby increase the perceived attractiveness of the innovation.

A second mechanism does not require observing the results of the innovation. If a farmer considers the circumstances of earlier adopters similar to his own, then their decision provides him with valuable information. He need not observe the consequences of that decision but

only the decision itself. This enables him to act as a free rider. Acquiring and evaluating further information about the new activity is then unnecessary: others have already done that and since they are similar their decision can be copied.

Hence one mechanism is based on observation of the results of adopters while the other one involves reliance on their information gathering and decision taking. Both these mechanisms are involved in sequential copying.

In the case of simultaneous copying the probability that one farmer will adopt is an increasing function of the probability that another farmer will adopt. In this case the copying effect is not based on observing the results of the decisions taken by others: decisions are taken simultaneously or at least so close together in time that the results obtained by early adopters provide little information. (For tree crops this is quite likely because of long gestation lags.) In this case there is an external effect but not in the sense of free riding. While a farmer does not wait for others to take the decision, he can discuss the way he evaluates the available information with others. If others are leaning towards adoption this may make the farmer decide in favour of adopting himself.

For both forms of copying there may be peer group effects so that the effect of actual or intended adoption by others depends on who those others are. In particular, there may be gender effects so that the effect of the decisions and intentions of others are stronger if they are of the same sex. This is an issue which we will explore.

We use a logit specification to explain the adoption decision. A sequential copying effect can be measured by entering the number of households who have adopted earlier as one of the regressors. Simultaneous copying is based on the estimated probability that other households will adopt and this probability is, of course, to be explained by the logit. We therefore use a multi-stage estimation procedure. Writing y_i for the dependent variable which takes the value 1 if household i decides to adopt and otherwise 0, $y_i = 1$ if $I_i > I^*_i$ where I is an index linear in the explanatory variables and I^* is a stochastic variable with cumulative distribution F(.). Then, writing z for the probability of adoption conditional on I:

$$z = P\{y = 1 \mid I\} = P\{I > I^* \mid I\} = F(I).$$

Next we construct the variable x_i as a weighted average of the probabilities z_j, where j is taken over all households in the cluster, exept for household i. The index I is linear in the regressors X and the copying variable x:

$$I_i = X_i'a + bx_i$$

where a and b are coefficients.

In the first stage of the procedure the coefficient b is set equal to 0 and the maximum likelihood estimate of the vector a is derived. These coefficients are then used to derive for all households the estimated value of I_j which is then used to construct z_j and finally the estimated value of the weighted average x_i.

In the next stage of the logit estimation the estimated value of x is added as a regressor. This provides a first estimate of b which can be used to revise the estimate of I. This procedure is repeated until the estimated value of b converges. For these and other logits use was made of a SAS programme, developed by Günther Maier, IIR, Vienna.

Investment Decisions in Kenya

We begin by estimating a logit for the adoption of coffee, using the 1982 survey (described in Bevan et al. (1989)) which has observations on 783 rural households. There are four groups of explanatory varables in the coffee logit. The first group consists of variables which describe characteristics of the household head: SEXH (1 for female, 0 for male heads), AGEH (the head's age), AGESH (the square of age) and EDUCH (a dummy variable which takes the value 1 if the head has at least some primary education). Variables in the second group describe the household and its holding: NM and NF (the number of male and female household members over the age of 15), ALAND and GLAND (the size of the

Table 1 : Variables in Coffee Adoption Logit (Kenya)

Variable	Mean
SEXH	0.307
AGEH	48.3
AGESH	2600
EDUCH	0.494
NM	1.42
NF	1.81
ALAND	3.22
GLAND	1.67
HOE	0.618
MALEP	0.876
PROVINCE	0.506
ACCOUNT	0.116
WAGE	0.145
URBAN	0.100
OWNBUS	0.066
CATTLE	3.96
PERGROWER	0.249

Table 2: Estimation Results for Coffee Adoption Logit (Kenya)
(No Distinction between Early and Late Adopters)

	First Stage	t	Final Stage	t
CONSTANT	-7.6	3.2	-8.0	3.3
SEXH	-1.9	3.2	-1.9	3.1
AGEH	0.14	1.9	0.15	2.0
AGESH	-0.0015	2.1	-0.0016	2.2
EDUCH	-0.33	0.7	-0.26	0.6
NM	0.008	0.0	0.0066	0.0
NF	0.29	1.4	0.27	1.4
ALAND	0.04	0.6	0.018	0.2
GLAND	0.07	1.4	0.077	1.5
HOE	-0.37	0.8	-0.28	0.6
MALEP	1.4	1.4	1.43	1.4
PROVINCE	2.1	3.8	1.78	2.8
ACCOUNT	-0.47	0.8	-0.42	0.7
WAGE	-0.68	1.0	-0.66	0.9
URBAN	0.29	0.4	0.29	0.4
OWNBUS	0.16	0.2	0.17	0.2
CATTLE	0.002	0.1	0.0028	0.1
PERGROWER	4.5	5.8	3.35	2.3
SIMCOP	---		1.82	1.0

note: * indicates an absolute t-value greater than 1 but less than 2,
** an absolute t-value greater than 2.

		Predicted			
		0	1	0	1
Actual	0	161	12	163	10
	1	32	36	30	38

holding's arable and grazing land), HOE (a dummy variable which takes the value 1 if ploughing is done only with a hoe), MALEP (1 if there is an adult male in the resident household or a husband or adult son away from the household who takes part in crop choice decisions) and PROVINCE (1 for Central Province, 0 for Nyanza). The next group of variables all refer to the household's position in 1975. They indicate whether the household had a bank account (ACCOUNT), whether a household member was in wage employment (WAGE), whether the head had an urban job (URBAN) or an own business (OWNBUS), and finally the number of cattle the household then owned (CATTLE). Finally, the potential for sequential copying is measured by PERGROWER, the proportion of households (other than the household considered) which already grew coffee in 1975.

Table 1 shows the means of these variables. Note that about 30 % of the households had a female head and that on 25 % of the holdings in the sample coffee was grown in 1975.

Our logit estimation is restricted to clusters in which coffee can be grown. We take this to be the case if at least one household (out of 20 in a cluster) grew coffee in 1982. In this restricted sample 241 households did not yet grow coffee in 1975. Of these potential adopters 173 still did not grow coffee in 1982, the other 68 had adopted the crop in the period 1975-1982.

As noted above, we adopt a multi-stage approach. In the first stage sequential copying is ignored: only the variables shown in Table 1 enter the logit. This gives the results in the first column of Table 2. The estimated coefficients are then used to calculate the estimated probability of adoption for each of the households in the sample. The variable SIMCOP, an indicator of simultaneous copying, is then constructed by calculating for each household the average expected probability of the other households in the same cluster. In the next stage SIMCOP is added to the logit. Expected probabilities are then calculated again, now taking into account the effect of SIMCOP on the probability. This procedure is repeated until the coefficient of SIMCOP no longer changes. The results of the final stage are shown in the second column of Table 2.

The logit correctly predicts the decision of 83% of the potential adopters: 94% of the non-adopting and 56% of the adopting households. Remarkably, the variables measuring the household's factor endowments (NM, NF, ALAND, GLAND) are not very significant. The same is true for pre-adoption cattle ownership, access to wage employment and urban connections.

The coefficients of the household head's age and sex are very significant. The coefficient of SEXH indicates that female headed households are less likely to adopt coffee. (Recall that SEXH is 1 for female heads.) The importance of this gender effect cannot be judged directly on the basis of the estimated coefficient. We therefore use the estimated coefficients in a simulation experiment in which the 74 female headed households are assumed to be male headed. The simulation measures both the direct effect of this change (via the coefficient of SEXH) and the indirect effect (via copying). The direct results of this change are that the sum of the probabilities of adopting in the sample (hence the expected number of adopting households) increases from 68 to 83. The number of households which are predicted to adopt (those with probabilities greater than 0.5) increases from 48 to 65. Hence there is a very strong direct effect: coffee would be much more widely adopted if female headed households were as likely to adopt as male headed households.

This direct effect induces some copying, so that more farms will adopt. As a result of this indirect effect the sum of the probabilities rises from 83 to 91. The number of households predicted to adopt increases from 65 to 70.

Taking the direct and the indirect effect together, the simulation experiment suggest that the number of adopters would be 46 % higher (70 instead of 48) in the absence of a gender effect. Hence the gender effects is substantial.

Of the 74 female headed households in the sample 66 did not and 8 did adopt coffee growing. Of these 8, only 2 were originally predicted to adopt. When the gender effect was excluded (i.e. pretending that the female headed households were male headed), these 8 are now all predicted to adopt, plus a further 12 female headed households out of the original non-adopters. The copying effect did not result in more of those female headed households now adopting, but did induce 5 male headed households to adopt now.

We also find evidence of both types of copying (PGROW and SIMCOP), in particular of sequential copying. However, the significance of the coefficient of SIMCOP is low.

Note that In Table 2 the effect of education on the adoption decision is not significant. In a separate logit (not further reported) we added an interaction term SEXH.EDUCH. The coeffient of this variablre is positive and (weakly) significant. Hence, while the head's education is not an important determinant of adoption in general, it does matter in the case of female headed households: educated female heads are more likely to adopt coffee.

Table 3: Estimation Results for Coffee Adoption Logit (Kenya) (Early and Late Adoption Distinguished)

	Early Adoption	t	Late Adoption	t
CONSTANT	-8.2	3.2	-4.3	1.4
SEXH	-2.0	2.9	-2.0	2.0
AGEH	0.19	2.0	0.04	0.4
AGESH	-0.0016	1.9	-0.00087	0.9
EDUCH	0.2	0.4	-0.095	0.1
NM	-0.2	0.9	0.18	0.7
NF	0.3	1.4	0.24	0.8
ALAND	-0.04	0.4	0.12	1.0
GLAND	-0.1	1.7	-0.03	0.3
HOE	-0.02	0.0	-0.84	1.1
MALEP	---		-0.14	1.1
PROVINCE	0.87	1.4	2.37	2.4
ACCOUNT	-0.1	0.2	-1.2	1.2
WAGE	-0.4	0.5	-1.0	0.8
URBAN	-0.4	0.5	1.37	1.1
OWNBUS	-0.3	0.3	0.27	0.3
CATTLE	0.017	0.6	-0.027	0.5
PERGROWER	2.7	2.1	2.6	1.7
EARLY	---		3.8	1.9
SIMCOP	2.1	0.9	1.4	0.7

		Predicted (Early) 0	1	Predicted (Late) 0	1
Actual	0	198	4	168	5
	1	29	10	16	13

(Note that the results given as "Actual" differ between the two columns. Of the 241 potential adopters 173 did not adopt in 1975-1982, 39 were early adopters and 29 were late adopters. In the first column, the non-adopters and late adopters are treated in the same way so that the total of the '0'-row is 202 (198 + 4 = 173 + 29). In the second column, only non-adopters are allocated to the 0-row so that the row total is 173, as in Table 2.)

(In the case of early adoption the variable MALEP was excluded from the logit; if it is included the matrix X is singular.)

Next we introduce two refinements. First, the estimate of the sequential copying effect can be improved by distinguishing between early and late adopters. This is relevant since late adopters have a better information set, having been able to observe early adopters. We distinguish between the two groups on the basis of the reported number of coffee trees. The survey records this number seperately for mature and immature trees. Households which adopted coffee after 1975 and whose coffee trees in 1982 are mostly mature are classified as early adopters. Late adopters can then be assumed to have been able to observe the adoption decision (and some of the early results) of the early adopters.

We then repeat the logit estimation separately for the two groups of adopters. In the case of early adopters the potential for sequential copying is measured as before, by PERGROWER, the proportion of households who were already growing the crop in 1975. For late adopters sequential copying is measured by PERGROWER and, in addition, by the proportion of early adopters, EARLY. The results are reported in Table 3.

The disaggregation does not affect the gender effect: the coefficient of SEXH is unchanged at 2.0 and it remains significant in both logits. The refinement provides better evidence of copying. The effect of simultaneous copying remains weak but the three coefficients measuring sequential copying (PERGROWER for early adopters, PERGROWER and EARLY for late adopters) are all significant at the 10 % level.

Table 4: Gender Specific Sequential Copying in Coffee Adoption Logit (Kenya)

SEXH	-1.7	(2.8)
PERGROWER		
own sex	3.1	(2.1)
opposite sex	-0.1	(0.1)
SIMCOP		
aggregate	2.4	(1.4)

Note: The results are for a logit which differs from that of Table 2 only in the gender disaggregation of the PERGROWER variable. (Absolute t-values within parentheses)

The second refinement concerns gender effects. So far we have established that the sex of the household head is important in the adoption decision: male headed households are more likely to adopt. We now consider the possibility that the copying effect is gender specific. We do this by disaggregation. Disaggregating by sex while maintaining the distinction between early and late adopters defines the six groups shown in Table 5. Note that the numbers in some cells are very small. This is why in Table 4 we aggregate over early and late adopters and introduce the gender disaggregation only for the sequential copying effect.

Instead of the aggregate variable PERGROWER we now enter separately the proportion of growers headed by a person of the same sex as the head of the household under consideration and the proportion of growers of the opposite sex. Otherwise the specification of the logit is the same as in Table 2.

Rather than showing all the estimation results, Table 4 focusses on the results for the gender and copying variables. The coefficient of the dummy for the sex of the household's head has not changed much, compared to Table 2 and is significant. The results further indicate that sequential copying as measured by PERGROWER (i.e. copying from those who adopted coffee before 1975) is gender specific: household heads are much more likely to copy from an adopter of the same sex. In that sense copying does appear to be a gender specific phenomenon. This is important because to the extent policies are biased in favour of male headed households this bias will be reinforced if female headed households are more likely to copy female than male headed households.

Table 5: Coffee Adoption by Gender (Kenya)

	male headed	female headed	total
non-adopters	107	66	173
early adopters	35	4	39
late adopters	25	4	29
total	167	74	241

We have estimated a similar adoption logit for the next investment decision, tea adoption, but this logit provides no significant results. The number of adopters is too small: there are only 25 adopting households of which 5 are female headed.

Next we consider the adoption of improved livestock. In the relevant population in 1975 there were 242 households (including 54 female headed households) without improved livestock. Over the period 1975-82 78 of those households (including 15 female headed households) adopted improved livestock. This suggests no gender difference: the proportion of female headed households in the group of adopters is about the same as in the group of potential adopters. This impression is confirmed if we control for other differences: in our logit (Table 6) the coefficient of SEXH is positive but has a t-value of only 0.2.

The variables in the logit have been defined previously except for: the size of the holding (LAND), dummy variables indicating whether "farmer" was the household head's main occupation in 1975 (FARMER) and whether the household then grew coffee or tea (COFFEE, TEA). In analogy with PERGROWER, PEROWNER is the proportion of households (in the same cluster) who already owned improved livestock at the beginning of the period. The livestock logit is succesful in terms of its fit: 82 % of the cases are correctly predicted.

For improved livestock adoption the simultaneous (but not the sequential) copying effect is significant. The hypothesis that the effect is gender specific (as for coffee) was explored but rejected. The other gender effect (the sex of the head of the household) is, as already noted, not significant either.

Hence there appear to be no gender effects. A simulation, similar to the case of coffee adoption, assuming that all female headed households would be male headed, leads to a reduction of 3 adopters, due to the positive gender effect. This effect is entirely due to the copying effect, not to the direct effect. The latter effect is not strong enough to pull originally female headed farms below the threshold, but does have a mild negative influence on the expected rate of adoption. The strong copying effect then acounts for the 3 non-adopters.

These results all refer to the adoption of improved livestock. In the case of Tanzania the data do not allow us to distinguish investment in improved and traditional cattle. For Tanzania the analysis will therefore be applied to all investment in cattle. For comparability we repeat the Kenya analysis for this wider concept. The results are shown in Table 7. In this logit the sequential copying effect is significant, but the simultaneous copying effect is not. The coefficient of SEXH is now negative (i.e. female headed households are less likely to adopt, as in the case of coffee) but it is not very significant.

Table 6: Estimation Results for Improved Livestock Adoption Logit (Kenya)

	Final Stage	|t| value
CONSTANT	-6.4	3.5
SEXH	0.09	0.2
AGEH	0.09	1.4
AGESH	-0.00063	1.0
EDUCH	1.6	3.6
LAND	0.09	1.4
COFFEE	0.39	0.9
TEA	0.09	0.1
FARMER	0.36	0.9
ACCOUNT	1.2	2.7
PEROWNER	0.21	0.3
SIMCOP	3.4	3.4

		Predicted 0	Predicted 1
Actual	0	143	21
	1	37	41

Table 7: Estimation Results for Investment in Livestock Logit (Kenya)

	Final Stage	|t| value
CONSTANT	-3.29	2.4
SEXH	-0.39	1.3
AGEH	0.055	1.1
AGESH	-0.00035	0.7
EDUCH	0.58	1.9
LAND	0.27	3.2
COFFEE	1.42	3.6
TEA	0.70	0.8
FARMER	0.54	1.9
ACCOUNT	1.2	1.8
PEROWNER	1.49	2.4
SIMCOP	-0.27	0.3

		Predicted 0	Predicted 1
Actual	0	97	59
	1	42	126

Investment Decisions in Tanzania

For Tanzania the analysis is limited to livestock. Tea adoption cannot be analysed: there are no tea growers in the sample. In the case of coffee there are growers in the sample but and only five adopters, all of them male. The small number op adopters should come as no surprise: unlike in Kenyan, there was no substantial increase in the producer price for coffee in Tanzania.

Recall that for Tanzania we analyse total livestock adoption: limiting the analysis to improved livestock is not possible. The results are shown in Table 8. The logit's fit is unsatisfactory. While out of 251 cases 222 are predicted correctly, the logit is unsuccesful in identifying adopters: of the 29 households who adopted cattle between 1975 and 1982, only 4 are correctly identified.

Simultaneous copying effects are not reported: the estimation procedure showed too high a correlation between PEROWNER and SIMCOP to allow convergence of the estimate. However, the results do suggest that sequential copying (as measured by PEROWNER) is important.

There is a gender effect (although not a very significant one: t = 1.6): the coefficient of SEXH is negative, suggesting less adoption by female headed households.

Table 8: Estimation Results for Investment in Livestock Logit (Tanzania)

	Final stage	|t| value
CONSTANT	7.5	2.8
SEXH	-1.2	1.6
AGEH	0.17	1.5
AGESH	-0.0019	1.6
EDUCH	0.53	1.1
LAND	0.77	1.6
FARMER	0.24	0.4
ACCOUNT	-0.31	0.3
PEROWNER	6.0	4.5

		Predicted 0	Predicted 1
Actual	0	218	4
	1	25	4

Investment Decisions in Côte d'Ivoire

For Côte d'Ivoire we have no direct evidence on adoption. Unlike in the East African surveys, in the Ivorian surveys households were not asked about their planting. However, when a household grows a tree crop we do know whether its trees are young. We therefore adopt the (rather crude) definition that a household is an adopter if all its trees are young. This is unsatisfactory since if we applied this definition to Kenya and Tanzania it would exclude all the "early adopters" and some of the "late adopters". This obviously limits comparability.

Our estimate for coffee adoption, shown in Table 9, is much less succesful than for Kenya and Tanzania. While 92 % of the 526 cases are correctly predicted, the logit is biased towards predicting non-adoption. (In the Côte d'Ivoire sample there are many clusters with only a single reported coffee grower. Since the clusters are larger than in the East African surveys, we considered the presence of one grower insufficient evidence that the crop could be grown by all other households in the cluster. Unlike for Kenya and Tanzania, a cluster is therefore included only if there are at least 2 coffee growers.) In fact, of the 41 adopters not one is predicted correctly. In addition, we did not succeed in estimating a simultaneous copying effect: the multi-stage procedure described earlier did not converge.

The Table therefore reports the results for the first stage in which the simultaneous copying variable (SIMCOP) does not appear. There is however evidence of sequential copying. Indeed, PERGROWER and ALAND are the only significant variables in the logit: coffee adoption seems to be determined largely by land availability (suggesting economies of scale) and by copying.

Gender effects seem unimportant. The coefficient of SEXH is negative, indicating that female headed households are less likely to adopt. Also, the coefficient of NM is positive while that of NF is negative: an increase in household size makes coffee adoption more likely provided the additional household members are male. However, all these gender effects are weak: none of the three coefficients involved is significant. (There would appear to be a gender effect if ALAND were excluded from the logit: the probability of adoption rises with the size of the holding and since female headed households have smaller holdings they are less likely to adopt. However, controlling for land size this apparent gender effect disappears.)

Table 9: Estimation Results for Coffee Adoption Logit (Côte d'Ivoire)

	Final Stage	|t| value
CONSTANT	-1.3410	0.8
SEXH	-1.0000	1.0
AGEH	-0.0648	0.9
AGESH	0.0004	0.5
EDUCH	0.0183	0.0
NM	0.0078	0.1
NF	-0.0539	0.4
ALAND	0.0620	2.4
ACCOUNT	-0.6792	1.3
COOP	0.4587	0.9
PERGROWER	1.7460	2.2

		Predicted 0	Predicted 1
Actual	0	484	1
	1	41	0

Next we consider cocoa adoption. The variables which enter the logit for cocoa have all been defined previously, except for a dummy variable indicating membership of a cooperative (COOP). The results are reported in Table 10. The overall fit of the logit is quite satisfactory: the adoption decision of the 528 potential cocoa adopters is predicted correctly in 78 % of the cases. However, there is a bias towards predicting non-adoption: in 21 % of the 515 cases for which the logit predicts non-adoption, households in fact adopted.

There is evidence of both types of copying effects, sequential and simultaneous. However, the SIMCOP variable, measuring simultaneous copying is not significant. The sequential copying variable, PERGROWER, is highly significant. (The refinement we introduced in the Kenya case, based on the distinction between early and late adopters, is one which the Ivorian data do not allow.) The household head's education, cooperative membership and especially the cropped area of the holding (ALAND) are very significant.

Adoption rates differ markedly between holdings of different size. For holdings with a cropped area of up to 3 ha. it is only 11 %. For holdings of 3-6 ha., 6-12 ha., 12-20 ha. and holdings above 20 ha. the rate rises to 29%, 25%, 31% and 38% respectively.

Remarkably, the sex of the household head does not seem to matter. (This may be due to the small numbers involved. We have pooled the 1985 and 1987 data to increase the number of female headed households. Even so there are only 6 cases of female headed households which adopt.) There is however another gender effect: the number of males in the household is significant and has a positive effect on cocoa adoption, while the coefficient for the number of females is negative and not significant.

Conclusion

In the case of investment in livestock our evidence is mixed: in Tanzania we found a gender effect: female headed households were less likely to acquire cattle, but in Kenya there was no significant difference between male and female headed households. In the case of cocoa growing in Côte d'Ivoire there also was no significant difference in the probability of adoption between male and female headed households. However, there was another gender effect: the household's composition in terms of men and women did matter. Households with more male resident household members are more likely to adopt cocoa. Our strongest evidence on gender effects is for coffee adoption in Kenya. There we found a strong direct effect (male headed households being more likely to adopt), reinforced by a copying effect.

Table 10: Estimation Results for Cocoa Adoption Logit (Côte d'Ivoire)

	Final Stage	|t| value
CONSTANT	-2.867	2.1
SEXH	0.0985	0.2
AGEH	0.0049	0.1
AGESH	-0.00018	0.3
EDUCH	0.4054	1.4
NM	0.1245	1.2
NF	-0.0462	0.5
ALAND	0.0865	3.8
ACCOUNT	0.2259	0.7
COOP	0.4518	1.3
PERGROWER	1.844	2.7
SIMCOP	1.269	0.8

		Predicted	
		0	1
Actual	0	406	7
	1	109	6

Gender Effects in Agricultural Product Mix

Introduction

The combination of crops (and livestock) can be affected by gender effects in three ways. First, there may be gender effects in adopting innovations such as growing tree crops. This is the issue addressed in the previous section. Secondly, there may be a division of labour such that some crops are considered "female crops". In that case the sexual composition of the household will affect its agricultural product mix.

Table 11 shows some evidence on this question for Kenya. The evidence is negative. The results in the second column of the Table indicate that there are no clear "male crops", at least not in the sense of all the work being done by men. There are many more plots on which all work is done by women. However, there is in this respect no clear difference between food and cash crops: for example, the percentage of maize plots on which all labour is female (27 % for local maize, 29 % for hybrid maize) is very similar to the percentage for coffee or tea plots (21 % in both cases). The only clear example of a "female crop" is beans.

Table 11: Labour Use by Gender and Crop (Kenya)

	all female (%)	all male (%)	female share on all plots (%)
local maize	27	12	59
hybrid maize	29	7	64
beans	49	10	71
millet	28	9	60
cassava	31	12	76
potatoes	36	9	64
coffee	21	5	58
bananas	25	12	57
tea	21	2	65
pyrethrum	9	2	60

Note. For each crop the percentage of plots on which all labour is done by women or by men is shown in the first two columns. For all plots taken together the share of female household members in total labour input on the plot is shown in the last column. The Table is restricted to crops grown on at least 50 plots in the survey.

The third column of the Table is the most interesting one because for most crops combinations of male and female labour are reported for 60 to 70 % of the plots. On all plots taken together, the bulk of the labour is, not unexpectedly, done by women. However, the share of women in total labour input seems to differ very little between crops. Again, there is no basis for identifying female crops.

The shares in Table 11 are calculated for pure stands only since for mixed stands no crop specific labour data are available. Tables 11a and 11b extends the evidence to all major crops, or crop combinations. Not all crop combinations are included. The cut-off point was that the crop combination should occur on at least 1 per cent of all plots.

Table 11a. Percentages of gross and net income and of total male and female labour per major crop combination.

%Y-GROSS	%Y-NET	%MALE	%FEM	freq(%)	crop
3.63	2.37	4.59	4.98	5.6	local maize
4.71	4.11	7.35	7.97	8.1	hybrid maize
1.78	1.65	1.54	2.27	4.1	beans
3.57	3.59	2.33	3.50	4.0	beans, local maize
10.73	10.00	11.73	14.99	11.2	beans, hybrid maize
1.99	1.79	2.10	2.29	3.6	millet
1.43	1.08	2.49	3.00	3.2	cassava
0.51	0.27	1.40	1.65	3.0	sweet potatoes
0.05	0.03	0.42	0.48	1.1	sukuma wiki
0.50	0.40	1.32	0.81	1.5	'other vegetables'
12.62	5.46	11.84	9.00	6.9	coffee
2.59	2.78	2.00	1.83	2.9	bananas
10.26	10.73	6.19	7.36	4.3	tea
2.01	2.88	1.60	1.65	2.1	pyrethrum
13.74	12.20	11.33	8.49	16.6	'other crops'

Table 11a presents the figures for Kenya: the most frequent crop combination is that of beans and hybrid maize. This combination contributes 10.7 per cent to total gross agricultural income (including income from the sale of milk) and 10 per cent to net income. The crop combination uses 11.73 per cent of all male labour and 14.99 per cent of all female labour on the farm. Hence, there is a bias towards more female labour for this crop combination. Crops like coffee and the category 'other crops' appear to be more male crops.

On a more aggregate level, of all male time spent on the farm, 68 per cent is used for the above mentioned crops (or combinations), whereas 20 per cent is used for cattle and 12 per cent for minor crops (combinations). Of female labour, 70 per cent is used for major crops, only 15 per cent for cattle and another 15 per cent for the other crops.

Using the average incomes per crop or crop combination and weighting these with the shares of male and female labour allocated we can calculate average returns to male and female labour. This is done in Table 11b, seperately for gross and net income.

Table 11b. Average income weighted by male and female time allocations.
KENYA

		all crop combinations	major crop combinations
gross income	male	2042	1354
	female	1828	1329
net income	male	1365	830
	female	1259	853

Table 11b shows that the differences between men and women are rather small. If women's time would be allocated disproportionately to lower valued crops then this would show up as a lower average income. There is indeed some difference in average income, when the average is taken over all crop combinations, rather than over the major crops only. This shows that men are relatively more involved in growing quite profitable, but minor crops. In the case of the Kenya, these include crops like sugar cane. In addition, there is some indication that men are more involved in crops that use more inputs like seed, fertilizer and the like. Hence the gender difference is slightly smaller for net income (8%) than for gross income (10%).

For Tanzania, the situation is very similar. Table 11c shows the allocations to the major crops. The Table shows that by far the major crop is local maize, contributing no less than 13 per cent to gross income and requiring over 16 per cent of all female time (including time devoted to cattle). There are no "typical" male and female crops, but male time appears to be allocated relatively more to tobacco and pyrethrum.

Table 11c. Percentages of gross and net income and of total male and female labour per major crop combination. Tanzania.

%Ygross	%Ynet	%male	%female	freq(%)	CROP
13.17	12.75	13.77	16.31	11.98	local maize
4.38	3.89	6.8	6.34	4.34	hybrid maize
3.21	3.34	0.6	0.89	1.48	beans
8.88	8.96	3.45	3.76	3.82	beans, local m.
2.05	1.85	0.82	1.04	1.37	beans, hybrid m.
6.90	7.10	3.51	3.61	5.59	millet
0.46	0.41	1.89	1.59	2.17	sorghum
2.54	2.66	1.64	2.07	2.91	cassava
3.06	3.07	1.55	1.23	2.85	ground nuts
3.25	3.41	2.57	4.87	2.34	wheat
4.87	4.97	4.03	3.78	4.22	rice
0.53	0.53	1.45	2.13	1.54	peas
1.98	2.05	2.31	2.66	1.37	coffee
1.92	1.98	2.46	3.28	1.60	bananas, coffee
3.39	3.34	1.26	0.93	1.71	tobacco
0.41	0.41	2.12	1.68	1.43	pyrethrum
0.77	0.81	0.56	0.66	1.60	cashew nuts

On the more aggregate level, of all male time used in agriculture, 51 per cent is used for the crops shown in Table 11c, while 26 per cent is used for cattle and 23 per cent is allocated to other crops or crop combinations. Female time allocation is 57 per cent to the crops shown, only 18 per cent to cattle and 25 per cent to other crops.

Weighing the average incomes per crop combination with the shares of male and female time allocated to the combination gives the results in Table 11d. Again, like in Kenya, the differences are small. The average income for female labour is about 8% lower than for male labour (both for gross and for net income). Note that the average income over all combinations is higher than the average taken over the major crops only. This shows that the minor combinations are relatively profitable.

Table 11d. Average gross and net income, weighted with male and female shares in time allocation. Tanzania.

	weights	all crop combinations	major crop combinations
gross income	male	3177	2403
	female	2922	2439
net income	male	2983	2240
	female	2748	2284

As male time is allocated to these minor crops more than female time, overall average income, weighted with male shares is higher than overall income weighted with female shares. Differences between gross and net income are rather small in Tanzania, compared to Kenya, and show no particular gender bias.

For Kenya, the data are such that production and sales of the crops of each plot can be traced. This makes it possible to investigate whether women, more perhaps than men, are engaged in the cultivation of crops that are kept for home consumption.
Table 11e shows the percentages sold of each of the major crop combinations. Of some crops, like coffee and pyrethrum, almost 100 per cent is sold, whereas of local maize only 12 per cent is actually sold.

Table 11e. Percentage sold of major crop combinations. Kenya.

crop	% sold
local maize	11.9
hybrid maize	30.6
beans	28.9
beans, local m	19.2
beans, hybrid m.	29.2
millet	12.4
cassava	21.4
sweet potatoes	31.0
sukuma wiki	32.6
'other veg'	62.3
coffee	99.6
bananas	41.3
tea	98.8
pyrethrum	99.1
'other crops'	29.0

Of these major crop combinations, on average 39.6 per cent was sold.
If the mean percentage sold is calculated using the female labour time allocation as weights, we arrive at 45.4 per cent, and if we use male time allocation as weights, we end with 48.2 per cent. This shows that

a) more time is allocated to crops that are sold relatively more (this is due to the labour intensive nature of many cash crops) and

b) female time, more than male time is allocated to subsistence crops.

These percentages are confirmed for the whole of all crop combinations. Average percentage sold is 38.7 per cent. Using 'female time weights' this mean value rises to 41.7 per cent and with 'male time weights' the value rises further to 45.6 per cent.

Finally, it is possible that gender effects influence the household's product mix directly. So far we have considered the adoption of a single agricultural activity. We do this by estimating a log linear model to explain a household's agricultural product mix. Single activity studies of gender effects can be very misleading: they ignore that a gender effect does not operate on a single activity but on the whole product mix. The use of the log linear model avoids this problem.

Product mix is defined by distinguishing five agricultural activities: food crops (denoted FD in the Tables), cash crops, excluding tree crops (CC), tree crops (CT), cattle (CW) and a residual default category. Indicating an activity i $d_i = 1$ if a household is engaged in it and -1 otherwise, four binary variables describe the product mix. For example, for a household with food crops and cattle but no cash crops the combination: (d_1, d_2, d_3, d_4) is described by (1, -1, -1, 1). We now attempt to explain combinations of activities with a log-linear model.

In its "fully saturated" form the log-linear model may be written as:

$$
\begin{aligned}
\log P(d_1, d_2, d_3, d_4) = u_0 & \\
& + u_1 d_1 + u_2 d_2 + u_3 d_3 + u_4 d_4 \\
& + u_5 d_1 d_2 + u_6 d_1 d_3 + u_7 d_2 d_3 + u_8 d_1 d_4 + u_9 d_2 d_4 \\
& + u_{10} d_3 d_4 + u_{11} d_1 d_2 d_3 + u_{12} d_1 d_2 d_4 + u_{13} d_2 d_3 d_4 \\
& + u_{14} d_1 d_3 d_4 + u_{15} d_1 d_2 d_3 d_4
\end{aligned}
$$

The estimation procedure starts from this fully saturated version and first eliminates insignificant terms. In the second stage it tries to explain the coefficients u_i by making them functions of explanatory variables.

Product Mix in Kenya

Table 12 shows the results for Kenya. Here in the first stage the log linear model was reduced to one of the main effects (FD) and three first order interaction terms: FD.CC, FD.CT and FD.CW. Hence the model was:

$$\log P(FD, CC, CT, CW) = u_1 FD + u_2 FD.CC + u_3 FD.CT + u_4 FD.CW$$

where $P(d_1, d_2, d_3, d_4)$ denotes the probability of combination (d_1, d_2, d_3, d_4). The coefficient u_0 acts as a scaling factor ensuring the probabilities sum to unity.

The coefficients u_i $(i>0)$ were made functions of binary explanatory variables indicating the head's gender, head's education, number of males, number of females and size of the holding. Only significant explanantory variables are maintained in the final, reported version. In the case of Kenya, two variables are kept, indicating whether the household head was male (SEXH) and whether the holding was larger than 3 ha. (LD):

$$u_i = a_i + b_i SEXH + c_i LD.$$

The results are shown in Table 12. The coefficients in the LD column indicate that having a large cropping area makes a product mix which goes beyond the basic one (food crops only) more likely. This does not favour specialisation but combinations of food crops with one of the other three activities.

Table 12: Product Mix Log Linear Model (Kenya)

		constant		SEXH		LD	
i		(a_i)		(b_i)		(c_i)	
			t		t		t
1	FD	1.491	10.4	-.00882	0.1	.0539	0.4
2	FD.CC	-0.922	15.2	.0488	0.8	.239	4.4
3	FD.CT	-0.289	6.7	.111	2.6	.0586	1.5
4	FD.CW	0.947	15.5	.0803	1.4	.150	2.5

Activity Codes: FD food crops, CC cash crops (excluding tree crops), CT tree crops, CW cattle.
Explanatory Variables: SEXH (male head of household) and LD (large cropping area).

The second column provides evidence of gender effects. Male headed households are more likely to add livestock or tree crops to the product mix. The gender effect is especially significant for the case of tree crops.

Consider the probability of the product mix (1, -1, 1, -1), i.e. the combination food crops and tree crops but no other cash crops or livestock. For a household with a "large" holding (LD = 1) this gives:

$$
\begin{aligned}
\log P(1, -1, 1, -1) &= u_1 - u_2 + u_3 - u_4 \\
&= (1.491 + 0.922 - 0.289 - 0.947) \\
&\quad + (-0.00882 - 0.0488 + 0.111 - 0.803)\ \text{SEXH} \\
&\quad + (0.0539 - 0.239 + 0.0586 - 0.150) \\
&= 1.177 - 0.8583\ \text{SEXH} - 0.2765
\end{aligned}
$$

Similarly, the probability that the household only grows food is given by:

$$\log P(1, -1, -1, -1) = u_1 - u_2 - u_3 - u_4$$

and hence the relative probability of the combination food and cash crops rather than food crops only is:

$$
\begin{aligned}
\log P(1, -1, 1, -1) / P(1, -1, -1, -1) &= 2u_3 \\
&= 2\ (-0.289 + .111\ \text{SEXH} + 0.0586)
\end{aligned}
$$

Hence the (natural) logarithm of the relative probability is -0.6828 for a female headed household (SEXH = -1) and -0.2388 for a male headed household. This indicates a strong gender effect. For female headed households the probability of the food plus tree crop combination is about 51 % of that for food alone but for male headed households the percentage is much higher: 79%.

Product Mix in Tanzania

Next we consider the same model for Tanzania. There are some important differences. First, while for Kenya the one main effect of the log linear model which was maintained was the one for food crops, for Tanzania we find that all households grow food crops so that the variable FD is not maintained. The other three main effects: CC, CT and CW and one of the first order interaction terms, CT.CW, are maintained so the model is (ignoring u_0):

$$\log P(FD, CC, CT, CW) = u_1CC + u_2CT + u_3CW + u_4CT.CW$$

Secondly, while in the case of Kenya the only explanatory variables maintained were SEXH and LD, for Tanzania we keep in addition EDUCH, the dummy variable indicating whether the household head has had at least some primary education, and a variable indicating whether the household has at least two male members (of age 15 or above), DM.

Table 13 shows the results. The household's endowment in terms of male labour affects product mix only to a very limited extent: the explanatory variable DM is significant only for livestock. Whether the household head has some education, a variable which does not explain product mix for Kenya, is a significant determinant of tree crops and livestock (CT, CW and the interaction term CT.CW). Finally, gender effects are significant: SEXH positively affects cash crops and negatively affects tree crops and livestock.

Table 13: Product Mix Log Linear Model (Tanzania)

		constant		SEXH		LD		EDUCH		DM	
i		(a_i)	t	(b_i)	t	(c_i)	t	(d_i)	t	(e_i)	t
1	CC	-.8483	6.9	.2723	2.2	.1004	1.8	.0359	0.6	-.0231	0.4
2	CT	-.3800	4.5	-.1650	1.9	.1642	2.9	.1426	2.5	.0078	0.1
3	CW	-.1529	1.8	-.2078	2.4	.0669	1.2	.1376	2.3	.2703	4.5
4	CT.CW	.2505	2.0	-.1274	1.5	-.0235	0.4	.1221	2.1	.1175	2.0

Activity Codes: FD food crops, CC cash crops (excluding tree crops), CT tree crops, CW cattle.
Explanatory Variables: SEXH (male head of household), LD (large cropping area), EDUCH (head has some primary education) and DM (at least two male household members over the age of 14).

Product Mix in Côte d'Ivoire

Finally, for Côte d'Ivoire the estimation results are given in Table 14. For the sample as a whole, 98 per cent of the farms grow food crops, 68 per cent grow a tree crop, 52 per cent grow another cash crop and only 7 per cent has cattle. In the log linear model, only the four main effects are kept and interaction terms between these activities are not significant in the context of this model with more explanatory variables. The binary variables representing the number of males and number of females were not maintained since they were not significant.

Table 14: Product Mix Log Linear Model (Côte d'Ivoire)

		constant		SEXH		LD		EDUCH	
i		(a_i)	t	(b_i)	t	(c_i)	t	(d_i)	t
1	CC	-0.2223	4.0	0.0705	1.4	0.1711	5.5	-0.1581	5.3
2	CT	-0.0516	0.8	0.2127	3.7	0.5576	16.0	0.1392	3.8
3	CW	-2.1656	10.0	0.3456	1.9	0.2235	2.6	-0.4851	4.2
4	FD	1.4408	10.4	0.2732	2.1	0.2610	2.7	-0.1237	1.3

Activity Codes: FD food crops, CC cash crops (excluding tree crops), CT tree crops (coffee, cocoa, oil palm, rubber, coconut), CW cattle. Explanatory Variables: SEXH (male head of household), LD (large cropping area), EDUCH (head has some primary education).

The results differ from those found for Kenya and Tanzania. Gender effects all are in the same direction: male headed households have greater probabilities for any of the activities, least so for non-tree cash crops. Education works strongly in favour of growing tree crops. For example, consider the odds in favour of growing a combination of food crops and tree crops against only growing food crops. On large holdings, the odds are 5.6 to 1 if the household has a male head with some education, against 2.3 to 1 for a household with a female head with some education. For household heads without schooling, these odds are 3.2 to 1 for a male and 1.2 to 1 for a female head. Hence there are sunstantial differences in product mix between male and female headed households.

Conclusion

Our application of the log linar model suggests that there are significant and substantial differences between male and female headed households in their mix of agricultural activities. For example, for Kenya, female headed households are very much less likely to add tree crops to their food crops than are male headed households. This is confirmed for Côte d'Ivoire.

3. Gender effects and job choice of rural households

Introduction

In the previous section the analysis was limited to the resident household's choice of agricultural activities. In the present section we extend the analysis in two ways. First, we move from the "product mix" decision to "job choice" by adding off-farm employment as a separate activity: the resident household can decide to grow crops or to have livestock, as before, but now it can also allocate labour to off-farm employment. Our focus will be on gender differences in access to off-farm employment. In addition, we will compare government and private sector off-farm employment.

The second extension concerns the concept of the household. Instead of the resident household we consider the "extended household" which includes migrants who used to belong to the resident household. The migration decision then becomes part of the "job choice" problem: the household can choose to allocate some of its members to off-farm employment which requires migration.

The approach we adopt to analyse job choice is unconventional. Theoretically, it would be desirable to construct an optimizing model to explain the allocation of household members over the various activities. But this would require detailed knowledge not only of the characteristics of the household members (which we have), but also of the opportunities open to them (which we do not have).

This leaves us two options. The more traditional one is to consider the job choice of individual household members. This is normally done by ordinary logit models. However, this has the disadvantage of not allowing for intra-family substitution possibilities. When a household member migrates or engages in employment off-farm this is likely to affect the allocation of the other household members between activities. Similarly, having more hands available for farm work may increase the probability that one member seeks off-farm employment. We therefore model job choice as a household rather than an individual decision.

Initially, we consider only the resident household. Job choice is related to characteristics of the household head: AGEH, the head's age, complemented by dummies for under 30 (AGEH<30) and over 50 (AGEH>50), SEXH (taking the value of 1 for male and 2 for female heads), and EDUCH, calculated here as 10 times the level of schooling (primary = 1, secondary = 2 etc.) plus the number of years completed; and to the variables which characterize the household: NM (number of males), NF (number of females), NE1 (number of persons with only primary education), NE2 (number of persons with at least some secondary education), N15 (number of persons under 15), N25 (number above 14 but under 25); and, finally, to variables describing the holding: its size, (in ha.), CRPS, the total value of cattle (CATVAL) in shilling, and the acreage under tree crops (ACT) and that under other cash crops (ACC). The acreage variables were deemed exogenous because of the long term nature of tree crops, and because of the linkage to local processing infrastructure in the case of other cash crops.

In the model a household allocates its members over four categories: farm work (including off-farm work on estates or on other people's shambas), private employment (including own business), government employment and a residual category ("other"). The allocation data are based on the responses in the survey to questions about each household member's "main occupation".

Estimation of the model is by multinomial logit, where the household is considered as a group.

Kenya

For Kenya the results are shown in Table 15. Here the mean number of household members is 6.62 of which 2.42 are engaged in farm work, 0.29 in private employment, 0.04 in government employment and the remaining 3.87 (mainly children) in the residual category.

Female headed households appear to have more persons working in government employment than male headed households. The head's education level favours government employment as well. The more children, the more persons will be in the 'other' category so that N15 has a negative sign for the three other categories. Surprisingly, the area under tree crops or other cash crops has a negative effect on the allocation of people to farm work, but total size of the holding has the expected positive sign for this allocation, as does the variable CATVAL. As the coefficient for AGEH>50 shows, households with older heads are more directed towards agriculture.

Table 15: Job choice residential household, Kenya.
Farm work, Private, Government employment, Other.

	mean	farm	t	private	t	gov't	t
CONST	1.000	-0.016	0.1	-2.057	2.8	-4.476	5.4
AGEH	49.000	-0.004	0.8	-0.011	0.8	-0.002	0.0
AGEH<30	0.070	0.069	0.4	-0.108	0.2	-0.089	0.2
AGEH>50	0.486	0.240	2.2	0.203	0.6	-0.256	0.6
SEXH	1.300	-0.029	0.4	0.010	0.0	0.528	1.8
EDUCH	7.900	-0.010	2.1	0.025	1.9	0.072	5.1
NM	3.240	0.237	7.6	0.157	1.7	0.456	4.4
NF	3.390	0.241	8.0	0.071	0.8	0.439	4.5
NE1	3.430	-0.074	3.6	0.059	0.9	-0.076	1.1
NE2	0.450	-0.105	2.8	-0.019	0.2	0.529	5.4
N15	3.270	-0.402	12.5	-0.400	4.3	-0.684	6.7
N25	1.200	-0.191	5.3	-0.096	0.9	-0.466	3.9
CRPS	2.930	0.025	1.5	-0.090	1.5	-0.069	0.9
CATVAL	0.040	0.209	0.5	0.641	0.6	-4.218	2.0
ACT	0.379	-0.006	0.2	-0.010	0.1	-0.857	3.4
ACC	0.225	-0.060	1.7	0.130	1.5	0.125	1.2

Obviously, in a larger household more people will be allocated to some job. Hence the number of men (NM) and women (NF) has a positive effect for all three job categories. There is, however, a gender difference. For farm work the estimated coefficients for NM and NF are the same, but for private employment, the number of males is much more important than the number of females. For government employment gender does not seem to be an issue: the coefficients are virtually the same.

Having more educated people in the household negatively affects the labour allocation to farm work while an increase in the number of people with secondary education (NE2) favours government employment.

The model has been used in simulation experiments. For the "average household" (with mean values for all variables), the allocation of its members was calculated according to the logit model. We then added one person to the household. (Note that this changes several explanatory variables simultaneously: the number of males or females, the number of people with some education, NE1 or NE2, and the number of persons in a certain age group, N15 or N25.) This allow us to calculate the effects of an additional man or woman, a younger or older person, and a highly educated person, or someone without formal education.

Table 16 presents the results of simulations with one person added to the household, distinguished by sex and education. The logit yields a distribution of all persons over the four job types. These shares are multiplied by the new total (equal to the old total plus one). Next the resulting numbers in each job type was compared to the original allocation. The differences between the new and the old situation are reported here.

Table 16: Allocation of marginal household members. Kenya

Source	allocation in percentage of person			
	farm	private	gov't	other
1 extra male over 25				
with education level 2	56	4	13	26
with education level 1	65	6	4	25
with education level 0	79	4	4	12
1 extra female over 25				
with education level 2	58	2	13	27
with education level 1	67	4	4	25
with education level 0	81	2	4	13
	change in allocation in % of means			
+1 female, -1 male				
at average education level	+1	-5	+9	-0

For example, adding one male with secondary education to the average household results in 0.56 persons more in farm work, 0.04 persons more in off-farm private employment, 0.13 more in a government job and the remainder, 0.26 more in the "other" category. When a male with lower education would be added, the addition to farm workers would be larger.

We estimate gender effects by simultaneously adding a female member to the household while removing a male household member. The bottom row of Table 16 shows that this "sex change" has a strong effect on the allocation of persons in government employment. It increases the number of persons in government employment by 9 per cent. This was investigated in more detail by estimating and analysing a logit function over the persons working off-farm. This logit confirmed the gender effects on the choice between private and government employment. In addition, and also in accordance with the findings of Table 16, the level of education proved to be positively associated with the probability of selecting the government as employer, rather than private wage employment or own business.

Next we consider the effect of such a change on household income. This is done by explaining net income from the growing of crop from the numbers of persons working in each main occupation. Needless to say, agricultural income is not only generated by those having their main occupation in agriculture. Those stating no main occupation, e.g. students, are still active on the family farm and those that have off-farm occupations may spend part of their time doing farm work.

A regression was run relating net crop income to the number of persons in each of the four categories, with each number multiplied by all of the eighteen explanatory variables that appear in the multinomial framework. The results are shown in Table 17.

Table 17: Parameters of the equation for net crop income. Kenya.

	farm work	t	private	t	government	t	other	t
CONST	1125.84	1.0	5779.08	1.2	-3120.05	0.5	-318.03	0.4
AGEH	-15.69	0.8	-96.60	1.2	30.78	0.3	18.74	1.5
AGEH<30	-165.75	0.2	-1263.32	0.5	6304.29	1.3	-47.27	0.1
AGEH>50	214.89	0.4	2026.10	1.1	3221.55	1.0	-367.14	1.2
SEXH	297.22	0.9	-562.75	0.3	-1068.89	0.5	-269.48	1.2
EDUCH	0.21	0.0	-70.03	0.7	126.71	1.1	4.38	0.3
NM	-151.60	0.9	-355.43	0.4	-788.28	0.8	-1.74	0.0
NF	-77.97	0.4	-489.47	0.6	-384.10	0.4	-71.96	0.5
NE1	76.04	0.9	424.72	1.0	-291.73	0.6	-60.37	1.0
NE2	78.25	0.4	1203.94	1.7	-440.21	0.6	-172.02	1.5
N15	-11.80	0.1	-87.20	0.1	1119.15	1.3	86.67	0.6
N25	-18.25	0.1	130.97	0.1	1428.51	1.4	97.39	0.6
N35	136.40	0.6	523.53	0.5	915.65	0.7	46.74	0.3
ACT	14.24	0.1	258.34	0.3	-3414.30	2.2	36.38	0.4
ACC	-584.80	2.6	2000.73	3.9	3665.04	4.9	-310.32	2.9
CRPS	-8.52	0.1	-129.31	0.5	-3.20	0.0	55.15	1.0
CATVAL	0.03	1.3	-0.10	1.3	-0.02	0.1	0.03	2.2
OVERALL CONSTANT			472.46	0.5				

The contribution to net crop income per person with agriculture as main occupation is given in column 1 as a linear function of 17 variables. The impact of age, for example is not significantly negative. Changing the sex of the head of the household from 1 (male) to 2 (female) would increase the contributions that farm workers make, but decrease the contribution per non-farm worker. The marginal contribution of workers in each of the four categories is given in Table 18. These are calculated at the mean values of the explanatory variables and of the persons in each job.

Table 18: Marginal contribution to crop income, Kenya

for farm workers	382
for workers in private industry	-160
for government employees	358
for other persons	210
weighted average	262

Changing the sex of the head from the average value of 1.3 to 1 (male) would mean that these marginal contribution change to 263, -207, 594 and 324, respectively. Hence we find an interesting gender effect: the marginal contribution of farm workers to net crop income is substantiall lower (263 instead of 382) for male headed households than for female headed households. The opposite holds for 'other persons' and for government employees, whose marginal contributions are higher on male headed farms than on female headed farms. Note that their contributions need not be due to actual working hours made. It may be associated with the crop choice, or input use typical for households in which persons are employed by the government.

The marginal overall contribution of the sex of the head taken over all occupations is negative, as the change in other values outweighs the change in the contribution of farm workers. Similarly a marginal increase in the number of persons with secondary education will decrease the marginal contributions to crop income. This effect is due to negative sign for 'other' persons' contribution: the higher their education, the less likely they are to contribute to crop income.

In the second Table of this section, the allocation was given for an extra male person of various levels of education. Evaluated at the average values for the contributions to crop income, this would lead to

(for education level 2)
$0.56*382 + 0.04*(-160) + 0.13*358 + 0.26*210 = 309$

and for education level 1 to
$0.65*382 - 0.06*160 + 0.04*358 + 0.25*210 = 306.$

If the effect of the change in endowments on the contribution per worker would be taken into account, other marginal contributions would result. Thus, the marginal contribution of the four types of worker would change to 306, -91, -722 and 148 for education level 1 and to 309, 688, -870 and 36 for education level 2; evaluated at these levels the marginal contribution of an extra male person with primary education to crop income becomes 202 shilling, and with secondary education only 96 shilling. The total effect of the additional person would be different because those already employed would now have a different contribution per person as well. Estimated income effects according to the regression are, however, stronger than seems plausible. What remains is a robust effect of sex of the head of the household: female heads have farm family workers that make larger contributions to crop income.

Job Choice in Tanzania (Resident Household)

For Tanzania, the estimates of the multinomial allocation model are given in Table 19.
The results are to a considerable extent similar to those for Kenya. What is striking here, is the difference in coefficients between NM and NF, the number of males and the number of females over the different occupations.

Table 19 : Job Choice residential household; Tanzania

	means	nfarm	t	npriv	t	n.gov	t
CONST	1.000	0.189	0.7	-3.257	2.3	-4.552	3.5
AGEH	49.094	0.006	1.3	-0.030	1.2	0.033	1.6
AGEH<30	0.086	0.313	1.8	0.026	0.0	0.851	1.5
AGEH>50	0.466	0.006	0.0	0.501	0.8	-0.178	0.3
SEXH	1.118	-0.238	1.7	0.428	0.7	-0.499	0.8
EDUCH	20.594	-0.011	1.7	-0.023	0.8	0.063	2.4
NM	3.412	0.112	2.5	0.273	1.2	-0.393	1.6
NF	3.651	0.152	3.6	0.043	0.2	-0.160	0.7
NE1	3.287	0.013	0.5	0.512	3.6	0.288	2.2
NE2	0.066	-0.221	1.7	1.363	3.7	0.640	2.0
N15	3.269	-0.387	8.5	-0.706	3.0	-0.217	0.9
N25	1.410	-0.069	1.2	-0.341	1.2	0.239	0.9
N35	0.763	0.093	1.8	0.065	0.2	1.107	4.7
ACT	0.567	-0.003	0.1	-0.427	1.4	0.182	1.1
ACC	0.370	-0.036	1.2	0.143	1.0	0.171	0.9
CRPS	3.162	0.006	0.4	-0.042	0.4	-0.219	2.1
CATVAL	0.108	0.255	2.1	-1.517	1.3	-1.251	1.2

Whereas the coefficients of both in the first category, agriculture, are about the same, those in the second category differ greatly, having a high value (0.273) for men and a low value (0.043) for women: for males the probability of working off-farm in private employment is much higher than for females.

Education in particular makes people eligible for a government job, as indicated by the highly significant and positive values for the coefficients of NE1 and NE2. Unlike in Kenya, private sector employers also attach considerable value to education.

Simulations with this allocation model leads to the results of Table 20.
The results indicate that women have a higher probability of working at the farm or in government employment and - depending on the farm characteristics, especially the level of education - there can be a large difference in off-farm employment of sons and daughters.

Attempts at estimating the income effects of such changes in the allocation for Tanzania were not succesful.

Table 20; Allocation of marginal household members; Tanzania;

	percentages of person's time			
	farm	private	gov't	other
1 extra male between 25 and 35				
with secondary education	16	15	42	27
with primary education	73	4	23	0
without education	76	1	15	8
1 extra female between 25 and 35				
with secondary education	19	11	55	15
with primary education	77	2	32	-11
without education	81	0	21	-2
at mean levels:	in percentages of mean values			
- 1 male, + 1 female	+2 %	-22%	+24%	-2%
mean values (persons):	3.00	0.03	0.14	3.90

Extended household, Kenya

Finally, the exercise was repeated, but now including migrants. Excluded from the household were only the daughters who were reported as having left the farm for reasons of marriage.
The results for Kenya are given in Table 21.

Table 21. Job Choice of the extended family: Kenya

	mean	farm	t	off-farm	t	migrant	t
CONST	1.000	-0.120	0.5	-2.191	-3.6	-2.240	-6.1
AGEH	48.959	0.004	0.9	-0.006	-0.6	0.005	0.8
AGEH<30	0.070	0.069	0.4	-0.202	-0.6	0.325	1.4
AGEH>50	0.269	0.039	0.3	0.118	0.4	-0.0004	-0.3
SEXHB	1.300	-0.116	-1.5	0.058	0.3	0.585	5.8
EDUCH	7.915	-0.010	-2.2	0.046	4.7	-0.013	-1.9
NM	3.980	0.106	2.9	0.168	2.0	0.187	3.9
NF	3.712	0.122	3.2	0.143	1.7	0.123	2.5
NE1	3.974	-0.057	-2.9	0.015	0.3	0.022	0.8
NE2	0.774	-0.113	-4.0	0.126	2.1	0.175	5.1
N15	3.430	-0.267	-7.2	-0.372	-4.5	-0.403	-8.2
N25	1.550	-0.042	-1.0	-0.163	-1.7	-0.100	-1.9
N35	0.982	0.082	1.8	-0.016	-0.2	0.075	1.3
ACT	0.379	-0.013	-0.4	-0.255	-2.2	-0.066	-1.2
ACC	0.225	-0.058	-1.7	0.094	1.4	0.071	1.8
CRPS	2.932	0.029	1.8	-0.070	-1.6	-0.030	-1.2
CATVAL	0.040	0.279	0.7	-1.037	-1.0	-0.101	-0.2

SEXHB is a redefinition of the earlier variable SEXH. A female headed household is now classified as male headed if there was a husband in town. (The other variables describing the head such as AGEH are adjusted accordingly.) The variable SEXHB has a positive effect on the choice to migrate: female headed households are more likely to have migrants in the extended household. (Note that this is not due to absentee husbands because of the definition of SEXHB.)

Hence the result indicates that sons (or occasionally unmarried daughters) are more likely to migrate when there is no father on the farm.

Like in the previous multinomial model, the coefficients of NM and NF (the number of male, female household members) indicate that women are more likely to work on the farm. Secondary education (NE2) favours off-farm employment and migration: the best educated household members move away.

Simulations with the model confirm these findings. Table 22 shows the effects on labour allocation of an additional male or female household member (in the 25-35 years age group).

Table 22: Allocation within extended family, Kenya.

		farm	off-farm	emigrate	other
1 extra male	secondary education	28	11	52	9
	primary education	47	7	33	13
	no education	59	6	29	6
1 extra female	secondary education	34	10	44	12
	primary education	53	6	26	15
	no education	66	5	22	8
at mean values					
1 male less, 1 female more		5	-1	-5	1

Tanzania

For Tanzania, the results are presented in Table 23.

Table 23: Multi-nomial model of farm, off-farm employment, emigration and other. Tanzania. Groupwise estimation results.

	mean	farm	t	off-farm	t	migrant	t
CONST	1.000	0.199	0.7	-2.809	2.9	-3.108	6.6
AGEH	49.038	0.004	0.9	0.009	0.6	0.015	2.0
AGEH<30	0.088	0.461	2.7	0.349	0.7	0.749	2.6
AGEH>50	0.464	-0.021	0.2	-0.608	1.4	0.178	0.8
SEXHB	1.102	-0.208	1.4	-0.278	0.6	0.155	0.7
EDUCH	6.940	-0.010	1.8	0.040	2.4	0.004	0.5
NM	3.896	0.117	3.0	-0.187	1.2	0.168	2.7
NF	3.888	0.157	4.0	-0.160	1.1	0.053	0.8
NE1	4.343	0.005	0.2	0.212	2.6	0.081	2.4
NE2	0.193	-0.163	2.6	0.395	2.5	0.306	4.7
N15	3.350	-0.374	9.1	-0.258	1.7	-0.350	5.1
N25	1.730	-0.074	1.5	0.324	2.0	0.043	0.6
N35	0.968	0.048	1.0	0.473	2.9	0.205	2.7
ACT	0.370	-0.043	1.5	0.150	1.2	0.045	0.8
ACC	0.567	0.003	0.8	-0.172	1.0	0.072	1.5
CRPS	3.162	0.004	0.3	-0.150	2.1	-0.059	2.0
CATVAL	0.108	0.290	2.4	-1.530	1.7	-0.557	2.1

The effect of SEXHB, defined as in the case of Kenya, is here less significant, although the direction is the same: female heads have more migrant kin. Education of the head again favours off-farm employment. Unlike in Kenya, the size of the holding (CRPS) and the value of cattle (CATVAL) strongly favour on-farm employment, discouraging migration in particular. Migration is much more a male affair than a female one; this is less so in the case of off-farm employment. Secondary education strongly encourages off-farm employment and, slightly less, migration.

Simulations with this model are presented in Table 24.

Table 24: Allocation within extended family, Tanzania.

		farm	off-farm	emigrate	other
1 extra male	secondary education	13	12	62	14
	primary education	60	7	34	-1
	no education	64	4	28	4
1 extra female	secondary education	26	12	49	13
	primary education	73	7	23	-4
	no education	77	4	18	1
at mean values					
1 male less, 1 female more		10	0	-7	-3

Comparing the simulation results for Kenya and Tanzania, it is clear that education has a much stronger influence on job choice in Tanzania than in Kenya. Secondary education, in particular, leads to an allocation of an additional male person of only 0.13 on average on the farm, against 0.28 in Kenya. But then, secondary education is less common in the Tanzanian sample: 0.19 person in the extended family against 0.77 in the case of Kenya.

The gender effects are very similar in the two countries: changing one male into one female increases farm work, and decreases emigration.

Comparing the allocations of men and women in the two simulations, we see that there is little difference between sexes or countries in the allocation of labour to off-farm employment. Recalling the analysis on private and government off-farm jobs, where gender differences were found, it appears that the male dominance that characterized private off-farm employment is sufficiently compensated by female employment in government jobs.

Conclusion

In this section we considered gender effects in the choice of occupation. The residential household was shown to choose more often for government employment when the haed of the household was female. In addition, increasing the number of women would lead to a more than proportional increase in government employment of the household. Men rather move into private employment or own business.

Female headed households show higher marginal returns per person in farm work. However, this higher marginal return is outweighted by lower marginal contributions to net crop income by members in other job types, including those in the 'other' category.

In Tanzania, the effects of formal education on job choice are much stronger than in Kenya. Private employment is enhanced by education as well, unlike in Kenya.

4. Gender Effects and Extension Services

Introduction

In this section we address two questions: whether female headed households are disadvantaged in their access to extension services and, secondly, what consequences lack of access has.

Extension has often been regarded as a necessary instrument for the modernization of agriculture. Farmers werre supposed to lack knowledge about modern varieties and this not only reduced yields but also made farmers reluctant to adopt modern varieties, because of their perceived riskiness. Extension service would induce more widespread adoption of modern varieties and would lead to better cultivation techniques and higher yields. Extension officers would form the link between agricultural research centres and farmers. They would disseminate the results obtained in the centres, and - in the other direction - collect information on the needs and requirements of farmers.

For Africa it has often been suggested that this system does not work. One reason is lack of good agricultural research, and especially the lack of suitable improved grain varieties. Research centres are said to lack skilled personnel and appear not to be sufficiently aware of the environmental and economic circumstances in which farmers operate.

As to dissemination, the extension service (and its male officers) has been accused of directing its advice to men only.

In general, the extension service has been directed not towards traditional farmers but to farmers who adopt modern cash crops and export crops in particular. Its outreach is often a direct complement of the adoption of those crops, because the purchase of seed or trees or the sale of the crop can only be done through a cooperative society or marketing board and the extension service is connected to it.

As we will see, the situation is much like this in the three countries on which we have data. We start with Kenya.

Kenya

Since 1982 the Kenyan government has responded to criticisms concerning the male focus of its extension service by employing more female staff and by redirecting much of its services concerning food production to women instead of men. For the present study, it was envisaged that recent (1989) survey data would be available, enabling a comparison between the 1982 data and 1989 data. This would provide a unique opportunity for the assessment of any impacts that the redirection of the extension service policy may have had. Unfortunately, the 1989 data are not yet available.

The survey of 1982, described in detail in Bevan et al. (1989) provides information on the use of extension service. In addition, for each crop, questions were asked on the farmer's source of information Possible answers were 'tradition or father', 'visit by extension officer', 'demonstration', 'trial and error', 'neighbours' and 'read about the method'. For coffee, tea and hybrid maize the responses are shown in Table 25.

Table 25: Channels of Information for Various Crops (Kenya).

	a	b	c	d	e	f	total
<u>coffee</u>							
males	32	54	38	20	10	1	155
females	17	13	12	4	4	0	50
<u>tea</u>							
males	11	15	33	6	15		80
females	2	3	13	2	6		26
<u>hybrid maize</u>							
males	94	15	7	13	5		134
females	31	3	1	5		2	42

a: tradition
b: demonstration
c: visit by ext.w.
d: own trial & error
e: neighbours
f: read about it

The Table shows that tea is a special case: a high percentage of tea growers reported that they had learned about the method they were using through the extension service. This is presumably a reflection of the activities of the Kenya Tea Development Authority (Bevan et al., 1989, p. 12). The high frequency for extension service as a source of information is, however, not related to gender. For the other two crops, there does appear to be a gender difference: female household heads rely more on traditional sources of information.

The extent to which contact with extension workers leads to a change of method is shown in Table 26, based on the responses to the survey question "Have you changed your method in the past 5 years?"

Table 26: Extension Contact and Change of Method (Kenya).

	male head		female head	
<u>coffee</u>	changed method	no change	changed method	no change
no contact	9	53	0	18
contact	21	72	10	22
<u>tea</u>				
no contact	3	32	2	5
contact	4	41	3	17
<u>hybrid maize</u>				
no contact	10	104	1	35
contact	6	22	0	6

It is striking that, although tea growers have obviously been visited by extension workers, this has not led to any change of methods. For the other two crops, the influence of extension workers is rather clear: contact with the extension service does induce a change of method, although only for a small number of farmers. Of male coffee growers who had contacts with the extension service 23% changed their method compared to 15% for those without extension contacts. For female coffee growers the difference is larger: 50 per cent of those who had contact changed their method, whereas none of the other women did. For hybrid maize, the figures of Table 26 suggest a similar outcome, but the low numbers involved preclude a definitive answer.

Combining the information of Tables 25 and 26 it appears that female heads are more traditional in their sources of information, but when they come into contact with the extension service they do seem to be more inclined to change their methods.

There is no evidence of discrimination by the extension service: the share of female headed households in the cases where there is an extension contact is similar to their share in the population. Households which grow coffee or tea, and/or those that are member of a cooperative are most likely to be visited by an extension worker. Using a logit to explain extension contacts we found no gender effect, not even when cooperative membership is excluded as an explanatory variable (because of its possible endogeneity).

The data that are available on the production and the labour input into growing coffee, tea and hybrid maize do not, unfortunately, allow any firm conclusion on whether change of method, or contact with the extension service leads to higher yields.

Tanzania

In Tanzania the major crops for which extension service contacts were reported are coffee and local maize. Sources of information on farming methods are shown in Table 27.

Table 27. Channels of Information for Various Crops.(Tanzania)

	a	b	c	d	e	f	total (incl missing)
coffee (incl. mixed stands)							
males	34	16	1	0	1	3	73
females	11	2					17
local maize (pure stands)							
males	76	16	4	22	12	2	154
females	13	1	3				20

a: tradition
b: demonstration
c: visit by ext.w.
d: own trial & error
e: neighbours
f: read about it

There is considerable non-response to this question in the Tanzania survey. Compared to Kenya, the answers that are given indicate a more traditional agriculture, with only a limited influence of demonstrations.

Surprisingly, therefore, Table 28 shows that a large proportion of the male heads indicates that they have changed their methods in the past five years.

Table 28: Extension Contact and Change of Method (Tanzania).

Coffee	male head		female head	
	changed method	no change	changed method	no change
no contact	4	40	0	10
contact	18	11	2	5
local maize				
no contact	34	70	0	11
contact	34	16	2	7

Note: 'no contact' and 'no change' include missing observations.

Combining the evidence of Tables 28 and 29 it is clear that the demonstrations given in Tanzania do provide an inducement to change, but they are not so extensive as allowing them the status of (primary) source of information about the technique. Female heads appear to be as much exposed to demonstrations as male heads, or even more so. The women who have been exposed to them tend to change their method, whereas others report no change at all. In this respect, female heads are more conservative than men. Male heads respond strongly to information, but are also inclined to change their methods, without such information, but as a result of own trial and error or, much more often, "because others did so".

Of all female heads, 42 per cent has had contact in one form or the other, with extension services. For male heads this percentage was 41. In a logit for extension contact (not further reported) the main explanatory variables, apart from cooperative membership, were education of the head of the household and whether or not particular crops were grown, in particular tobacco. As in Kenya, no gender effects were found.

Côte d'Ivoire

Unfortunately, the data available for Côte d'Ivoire do not support any firm conclusions about gender issues related to the extension service. Few households in the data set are female headed, and little use is made of extension services.

Nevertheless, there is some indication of female household heads having less contact with the extension service than male heads.
Combining the data sets of 1985 and 1987 in order to have as large a sample as possible, we arrive at a sample population of 1890 agricultural households, of which 378 reported the use of extension service for one or more crops. Out of the 1890 households, only 112 are female headed and of those only 5 reported any contact with extension services. Hence only 1 per cent of the female headed households had any contact compared to 7 per cent for male headed households.

These differences may be due to other reasons, like differences in the crops grown. Evidence on this is shown in Table 29.

Table 29: Côte d'Ivoire: Extension Service by Crop, 1985

	no. of growers	(female)	no.of contacts	(female)
cocoa	454	10	56	1
coffee	519	12	49	1
rice	475	11	34	0
maize	816		16	
yam	689		4	
cassava	747		1	
vegetables	804		1	
bananas	537		0	

This indicates, not unexpectedly, that extension contact is more likely in the case of cocoa, coffee and rice, crops grown relatively less in female headed households.

A logit analysis was made in order to check the predictive power of whether or not these crops were grown.

Table 30: Logit of Extension Service Use (Côte d'Ivoire).

var	mean	coef	t-value
CONST	1	0.3641	0.5
LAND	7.957	0.0215	2.9
EDUCH	0.199	0.1046	0.7
NM	1.977	0.0314	0.7
NF	2.425	0.0396	1.0
SEXH	1.060	-1.7020	3.6
AGEH	50.616	0.0028	0.1
AGESH	2751.664	-0.00014	0.6
COCOA	0.451	-0.0883	0.6
COFFEE	0.484	-0.2981	2.2
OIL PALM	0.241	0.2402	1.7

peformance:		predicted 0	predicted 1
actual	0	1509	3
	1	377	1

The surprising result of Table 30 is that the growing of a particular crop per se does not induce the use of extension services. It is rather the size of the holding, and the sex of the household head that determine extension service use. This latter variable can, of course, have only minor predictive power, as only very few households are female headed.

Including membership of a cooperative as one of the explanatory variables (mean = 0.097) leads to highly significant and positive coefficient for this variable, without, however, changing the coefficients shown in Table 30 substantially. This logit estimate is not reported, because it may well be, as noted above, that cooperative membership is endogenous. (People join in order to make use of extension service).

When analysing in a similar manner the data per crop, the variable indicating the sex of the household head is no longer significant. In the analyses for cocoa and coffee, the only variables that have significant coefficients are the size of area grown, and the education of the head. (Cooperative membership would, if included, become significant as well).

The only variable that remains is therefore the size of the holding. Table 31 reports the extent to which extension contacts are correlated with the size of the holding.

Table 31: Number of Households by Land Size and Extension Contacts (Côte d'Ivoire, 1985 and 1987 combined)

	cultivated land (ha)				
	less than 3	3 to 6	6 to 12	12 to 20	over 20
with contacts	54	108	126	52	39
no contacts	495	443	392	133	60
% with contacts	10	20	24	28	39
<u>coffee growers only</u>					
with contacts	9	25	31	16	19
no contacts	98	250	284	117	57
% with contacts	8	9	10	12	25
<u>cocoa growers only</u>					
with contacts	5	27	38	16	20
no contacts	81	224	264	110	62
% with contacts	6	11	13	13	24

This shows that for Côte d'Ivoire there is a correlation between size of the holding and the use of extension service. Data do not reveal whether this bias is at the demand side (with the user) or at the supply side (the officer). There is some evidence of gender differences in the sense that women are less frequently contacted by the extension service, but this no longer holds when separate crops are considered. This suggests that the relatively few female headed households have characteristics such that they would not normally have contacts with the extension service even when they would have been male headed.

Unfortunately, the data do not enable us to assess the impact of the use of extension service: unlike for Kenya and Tanzania there is no informatiuon on change of farming method.

Conclusion

This section described the evidence on channels of information to farmers in Kenya and Tanzania. Female heads appear to be more traditional in their source of information: relatively few women report that they learned the method they are using from other sources such as extension service. The extension services in Kenya and Tanzania appear to reach female headed households as well as male headed households.

In Côte d'Ivoire this was not the case: the very few female heads that were using extension services were less in number than might be expected on the basis of their share in the population.

When analysed for specific crops in Côte d'Ivoire, the gender aspect becomes less important. What remains as a major factor in the explanation of the use of extension service is the size of the holding: those in the highest group (over 20 ha) use extension service 4 times as much as those in the lowest group (under 3 ha).

The Kenyan and Tanzanian evidence suggests that women, if they are reached by extension service (visit, demonstrations etc.) are more inclined to change their methods than men.

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